

## CLAIMS

What is claimed is:

1. A single-slot multi-flash-card reader comprising:
  2. an Integrated Device Electronics (IDE) interface for transferring data to a personal computer;
  4. an IDE converter, coupled to the personal computer interface, for converting multiple flash-card interfaces to a format used by the personal computer interface;
  6. wherein the multiple flash-card interfaces include a CompactFlash interface and smaller interfaces having fewer pins than the CompactFlash interface;
  8. a CompactFlash connector, coupled to the IDE converter, for receiving a CompactFlash card through a single slot in the single-slot multi-flash-card reader, the CompactFlash connector making electrical connection with the CompactFlash card for signals in the CompactFlash interface;
  12. an adapter, having a physical shape to removably insert into the CompactFlash connector, the adapter having a mating CompactFlash connector that fits the CompactFlash connector, the adapter also having a smaller connector, the smaller connector for fitting to other flash-memory cards having the smaller interfaces; and
  16. wiring means, in the adapter, connected between the smaller connector and the mating CompactFlash connector, for directly connecting signals from the smaller connector in the smaller interface with signals in the mating CompactFlash connector;
  19. whereby the adapter allows the other flash-memory cards having the smaller interfaces to fit into the CompactFlash connector through the single slot to be read by the IDE converter.

1           2.     The single-slot multi-flash-card reader of claim 1 wherein the wiring means  
2     connects card select signals from all of the smaller interfaces to card select signals in the  
3     CompactFlash connector;

4                 wherein the IDE converter includes card-detect means, coupled to sense the card select  
5     signals, for detecting presence of a flash-memory card inserted into the CompactFlash  
6     connector,

7                 whereby the IDE converter detects presence of CompactFlash and the other flash-  
8     memory cards having the smaller interfaces.

1           3.     The single-slot multi-flash-card reader of claim 2 wherein the wiring means  
2     connects signals from the smaller interfaces to signals CE1, CE2 in the CompactFlash  
3     connector;

4                 wherein the IDE converter includes card-type-detect means, coupled to sense the  
5     signals, for detecting a type of a flash-memory card inserted into the CompactFlash connector;

6                 wherein the type of flash-memory card detected includes CompactFlash cards and  
7     smaller flash-memory cards having the smaller interface;

8                 whereby the IDE converter detects the type of flash-memory card inserted including  
9     CompactFlash and the other flash-memory cards having the smaller interfaces.

1           4.     The single-slot multi-flash-card reader of claim 3 wherein the signals comprise  
2     signals CE1, CE2, address signals A0, A1 signals in the CompactFlash interface;  
3                 wherein the A1 signal is connected to a serial data signal in the smaller interface when

4           the smaller interface is a MultiMediaCard, Secure Digital interface or a Memory Stick  
5           interface,

6           whereby type detection is performed using the CE1, CE2 signals connected to the  
7           serial data signal of the smaller interfaces.

1           5.       The single-slot multi-flash-card reader of claim 4 wherein each type of the  
2           flash-memory cards for the smaller interfaces drives signals connected to the signals by the  
3           adapter to different logic levels;

4           wherein CompactFlash cards do not drive the signals,  
5           whereby the signals float for CompactFlash cards, but at least one of the signals are  
6           driven by the other flash-memory cards having the smaller interfaces when connected by the  
7           adapter.

1           6.       The single-slot multi-flash-card reader of claim 5 further comprising:  
2           pull-up resistors, connected to the signals from the CompactFlash connector, for  
3           pulling the signals high when the IDE converter and the flash-memory card are not driving  
4           signals connected to these signals,  
5           whereby the pull-up resistors assist card-type detection.

1           7.       The single-slot multi-flash-card reader of claim 6 wherein the wiring means is  
2           a passive wiring means without active components including integrated circuit chips,  
3           transistors, resistors, or capacitors,  
4           whereby the adapter is a passive adapter.

1           8.     The single-slot multi-flash-card reader of claim 7 wherein the smaller  
2     interfaces are selected from the group consisting of MultiMediaCard, Secure Digital, and  
3     Memory Stick flash-memory-card interfaces.

1           9.     The single-slot multi-flash-card reader of claim 8 further comprising:  
2                 a second adapter, having a physical shape to removably insert into the CompactFlash  
3     connector, the second adapter having a mating CompactFlash connector that fits the  
4     CompactFlash connector, the second adapter also having a second smaller connector, the  
5     second smaller connector for fitting to a SmartMedia flash-memory cards having the smaller  
6     interface for SmartMedia,

7                 whereby the second adapter connects SmartMedia flash-memory cards to the  
8     CompactFlash connector.

1           10.    The single-slot multi-flash-card reader of claim 9 further comprising:  
2                 a third adapter, having a physical shape to removably insert into the CompactFlash  
3     connector, the third adapter having a mating CompactFlash connector that fits the  
4     CompactFlash connector, the third adapter also having a third smaller connector, the third  
5     smaller connector for fitting to a Memory Stick flash-memory cards having the smaller  
6     interface for Memory Stick,

7                 whereby the third adapter connects Memory Stick flash-memory cards to the  
8     CompactFlash connector.

1           11.    The single-slot multi-flash-card reader of claim 10 wherein the CompactFlash

2 interface has 50 pins including power and ground pins;  
3 wherein the smaller interfaces have no more than 10 pins including power and ground  
4 pins.

1 12. The single-slot multi-flash-card reader of claim 10 wherein the IDE converter  
2 further comprises:

3 serial-to-parallel means, receiving serial data from the smaller interfaces, for  
4 converting serial data to a parallel data format for transfer to the personal computer,  
5 whereby serial data from the smaller interfaces is converted to parallel, but parallel  
6 data from CompactFlash cards are not converted.

1 13. A multi-flash-card reader comprising:  
2 an integrated Device Electronics (IDE) connection for transferring data to a host  
3 computer;

4 an Integrated Device Electronics (IDE) converter chip, coupled to the host connection,  
5 for converting signals from flash-memory cards to read data from the flash-memory cards for  
6 transfer to the host computer;

7 a first connector, coupled to the converter chip, for accepting a CompactFlash card  
8 inserted into a first slot for the first connector, the first connector having a parallel-data bus  
9 and an address bus and control signals for controlling parallel data transfer from the  
10 CompactFlash card to the IDE converter chip;

11 a second connector, coupled to the IDE converter chip, for accepting a SmartMedia  
12 card inserted into a second slot for the second connector, the second connector having a

13 parallel-data bus and control signals for controlling parallel data transfer from the SmartMedia  
14 card to the IDE converter chip; and

15 a third connector, coupled to the IDE converter chip, for accepting a MultiMediaCard  
16 or Secure Digital card inserted into a third slot for the third connector, the third connector  
17 having a serial-data pin and a clock pin for controlling serial data transfer from the MMC card  
18 (SD Card) to the IDE converter chip;

19 wherein the IDE converter chip controls parallel data and address transfer for the  
20 CompactFlash card, parallel data transfer for the SmartMedia card, and serial data transfer for  
21 the MMC card,

22 whereby multiple flash-memory cards can be read by the multi-flash-card reader using  
23 the IDE converter chip.

1 14. The multi-flash-card reader of claim 13 wherein the first connector, the second  
2 connector, and the third connector each have card detect signals for detecting presence of a  
3 flash-memory card inserted into a connector;

4 wherein the IDE converter chip senses a voltage change in the card detect signals from  
5 a connector and activates a routine to access the flash-memory card activating the card detect  
6 signals,

7 whereby flash-memory cards are detected by the IDE converter chip.

1 15. The multi-flash-card reader of claim 14 further comprising:

2 a fourth connector, coupled to the IDE converter chip, for accepting a Memory Stick  
3 card inserted into a fourth slot for the fourth connector, the fourth connector having a serial-

4 data pin and a clock pin for controlling serial data transfer from the Memory Stick card to the  
5 IDE converter chip;

6 wherein the IDE converter chip also controls serial data transfer for the Memory Stick  
7 card.

1 16. The multi-flash-card reader of claim 15 wherein the host connection is through  
2 an external cable to the host computer;

3 wherein the multi-flash-card reader is in an external housing separate from the IDE  
4 computer chassis,

5 whereby the multi-flash-card reader is external.

1 17. The multi-flash-card reader of claim 16 further comprising:

2 a removable mass storage, coupled to the IDE converter chip, for accepting a  
3 removable disk through a fifth slot in the external housing, the removable mass storage storing  
4 data from the flash-memory card in response to the IDE converter chip,

5 whereby data is transferred to the removable mass storage.

1 18. The multi-flash-card reader of claim 17 further comprising:

2 an activating switch, closable by a user, for initiating transfer of data from a flash-  
3 memory card inserted into the first, second, or third connector to the removable mass storage,  
4 the activating switch coupled to activate a transfer routine in the IDE converter chip,  
5 whereby user-activated data transfer to the removable mass storage is initiated by the  
6 activating switch.

1           19. The multi-flash-card reader of claim 18 wherein the activating switch operates  
2       when the host connection is not currently connected to the host computer,  
3               whereby the multi-flash-card reader is a stand-alone reader for transferring data from a  
4       flash-memory card to the removable mass storage.

1           20. The multi-flash-card reader of claim 19 wherein the removable mass storage  
2       accepts a removable tape or a removable rotating disk as a storage media.

1           21. The multi-flash-card reader of claim 15 wherein the IDE connection is through  
2       an internal cable to a board for the host computer;

3               wherein the multi-flash-card reader is in a computer chassis that contains the host  
4       computer,

5               whereby the multi-flash-card reader is internal.

1           22. The multi-flash-card reader of claim 21 wherein the multi-flash-card reader is  
2       located in a drive bay for an extra disk drive in the computer chassis.

1           23. The multi-flash-card reader of claim 15 wherein the IDE converter chip further  
2       comprises:

3               a memory for storing routines for detecting presence of the flash-memory cards in the  
4       first, second, and third connectors, and routines for transferring data from the flash-memory  
5       card to the host computer;

6               central processing unit means for executing the routines stored in the memory;

7           timers, coupled to the central processing unit means, for determining a time interval;  
8           Input-output means, responsive to the central processing unit means, for sensing input  
9       signals from the first, second, and third connectors, and for driving output signals to the first,  
10      second, and third connectors;

11           shift means, responsive to the central processing unit means, for shifting serial data  
12       from the third and fourth connectors, but for shifting parallel data from the first and second  
13      connectors.

1           24.     The multi-flash card reader of claim 23 wherein a first and a second command  
2       from the central processing unit expands the IDE connection to a plurality of devices.

1           25.     The multi-flash card reader of claim 24 wherein the first command awakens a  
2       device coupled thereto and the second command indicates a type of device coupled to the IDE  
3       connection.

1           26.     The multi-flash-card reader of claim 19 wherein the reader is designed into a  
2       self hosted appliance.

1           27.     The multi-flash card reader of claim 26 wherein the self-hosted appliance  
2       comprises an MP3 player.

1           28.     The multi-flash card reader of claim 26 wherein the self-hosted appliance  
2       comprises a keyboard.

1           29.     The multi-flash card reader of claim 26 wherein the self-hosted appliance  
2           comprises a monitor.

1           30.     The multi-flash card reader of claim 26 wherein the self-hosted appliance  
2           comprises stereo appliance.

1           31.     The multi-flash card reader of claim 19 wherein the reader is designed into  
2           handheld digital camera devices.

1           32.     The multi-flash-card reader of claim 19 wherein the reader is designed into  
2           handheld data collection scanner devices.

1           33.     The multi-flash-card reader of claim 19 wherein the reader is designed into  
2           personal digital assistant devices.

1           34.     The multi-flash-card reader of claim 19 wherein the reader is designed into  
2           pocket personal computer devices that use Microsoft Palm operating systems.

1           35.     The multi-flash-card reader of claim 19 wherein the reader is designed into  
2           hand terminal devices.

1           36.     The multi-flash-card reader of claim 19 wherein the reader is designed into  
2           personal communicator devices.

1           37.     The multi-flash-card reader of claim 19 wherein the reader is designed into  
2 advanced two-way pager devices.

1           38.     The multi-flash-card reader of claim 19 wherein the reader is designed into  
2 audio recorder and player devices.

1           39.     The multi-flash-card reader of claim 19 wherein the reader is designed into  
2 monitoring devices.

1           40.     The multi-flash-card reader of claim 19 wherein the reader is designed into  
2 projector devices.

1           41.     The multi-flash-card reader of claim 19 wherein the reader is designed into  
2 industrial computer devices.

1           42.     The multi-flash-card reader of claim 19 wherein the reader is designed into  
2 printer devices.

1           43.     The multi-flash-card reader of claim 19 wherein the reader is designed into  
2 human input devices.

1           44.     The multi-flash-card reader of claim 19 wherein the reader is designed into  
2 digital picture frame devices.